

Academic entrepreneurship in Hungary: Can the Bayh-Dole model of university technology transfer work in an Eastern European context?

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Abstract

My purpose is to identify, examine, and synthesize the main factors that determine the ability of Hungarian higher education institutions to adopt the Bayh-Dole model of university technology transfer. I begin by discussing a set of fundamental questions, such as the various interpretations of the recent changes in the posture of institutions, the criticism of the novel approach to the role of universities in society, and the main causes behind the increasing entrepreneurial activity of institutions. I scrutinize the determinants of university entrepreneurship at three interrelated levels: national (governance model of universities), organizational (university culture), and personal (individual scientist). I conclude that, in Hungary, none of the three components of the proposed framework facilitates the entrepreneurial transformation of institutions in line with the Bayh-Dole model.

Keywords

technology transfer · academic entrepreneurship · universities · Bayh-Dole Act

1 Introduction: the entrepreneurial transformation of universities

Higher education institutions (henceforth, institutions / universities) have always played a central role in the development of towns, regions, and nations. Their contribution to society's welfare has traditionally been indirect, i.e. by education, training, and the open dissemination of research results. In the last one and a half or two decades however, in parallel with the rise of various economic and social concerns, these unwritten norms of how universities should function seem to be eroding.

"Knowledge-producing institutions have become more important to innovation as knowledge becomes an increasingly significant element in new product development" [22]. Institutions that are active in commercializing research results (i.e. in *technology transfer*) and especially in patenting, licensing, or new firm formation are often referred to as "entrepreneurial" [30]. Although it is commonly referred to as technology transfer, commercializing inventions often goes beyond knowledge transfer and can rather be interpreted as a marketing process (especially in the case of spin-off ventures) [45]. [54] also highlights the need for "customer orientation" when devising university research and development (R&D).

Etzkowitz [17] coins the term *entrepreneurial university* to describe the increased technology transfer activity of higher education institutions that, as a result of closer industry ties, play an enhanced role in innovation and economic growth. According to Etzkowitz's much-quoted argument [20], higher education institutions have undergone a double transformation: the "first revolution" came during the 19th and 20th centuries, when in addition to education research became a legitimate mission of institutions. Towards the end of the 20th century, a "second revolution" took place, which brought about "the translation of research findings into intellectual property, a marketable commodity, and economic development" [24]. The commercialization of research results is often referred to as the "third role" or "third mission", which is "particularly well developed" in an entrepreneurial university [70].

Etzkowitz, one of the most prolific writers on the entrepreneurial transformation of universities, claims that *aca-*

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democratic entrepreneurship [italics added] is, on the one hand, an extension of teaching and research activities and, on the other hand, the internalisation of technology transfer capabilities, taking a role traditionally played by industry. It is this ‘capitalisation of knowledge’ that is the heart of a new mission for the university, linking universities more tightly to users of knowledge and establishing the university as an economic actor in its own right [19].

Clark [9] examines five European universities in five different settings, and calls for five elements as the “irreducible minimum” to make up an entrepreneurial university: (1) “the strengthened steering core” refers to greater managerial capacity; (2) “the expanded developmental periphery” implies that in order to link up with outside organizations, entrepreneurial institutions create units that reach across traditional university boundaries; (3) “the diversified funding base” denotes the fact that, in addition to government support, second and third stream sources are considered as an opportunity; (4) “the stimulated academic heartland” calls for changes to be realized at departmental level as well; while (5) “the integrated entrepreneurial culture” requires the transformation to result in a new organization culture.

Slaughter and Leslie [64] introduce the concept *academic capitalism* to pinpoint the growing involvement of institutions in market activity. On the basis of surveys at two Australian universities, the authors find that faculty members in general regard the costs of academic capitalism small as compared to its benefits. Slaughter and Leslie argue that technology transfer “is one of the most direct forms of academic engagement with the market, and as such, a signifier of the issues that academic capitalism presents” (p. 139).

The “Mode 1 / Mode 2” theory [28] and the “Triple Helix” model [23] also indicate a novel way of scientific knowledge production. Both models represent a non-linear approach to innovation and a pluralistic, interdisciplinary view of the national innovation system (NIS). In addition to Mode 2, Triple Helix asserts that the actors of the NIS take the role of each other: universities engage in entrepreneurial tasks (e.g. knowledge marketing and company creation), enterprises increasingly share knowledge among each other and with universities, while the government takes the role of venture capitalists [22, 25].

MIT is considered the finest exemplar of the entrepreneurial universities. Far ahead of its time, early in the 20th century, MIT institutionalized theretofore informal university-industry technology transfer: it created a patent system to protect intellectual property (IP), invention search mechanisms to identify applicable technology within the institution, committees to evaluate inventions, and a *technology transfer office* (TTO) to assist the commercialization of research results. The success of MIT was primarily due to the fact that it “combined the research university’s ‘linear model’ with the land grant university’s ‘reverse linear model’ predicated upon deriving research goals from societal needs” [21]. Stanford University, another prototype of aca-

democratic entrepreneurship, developed its technology transfer skills in parallel with the rise of Silicon Valley. Despite these early archetypes, university technology transfer in the U.S. began to receive increased attention from scholars only in the aftermath of the Bayh-Dole Act (1980). The Bayh-Dole (BD) legitimized and institutionalized university technology transfer by granting rights over faculty’s research results to the institution.

In Europe, universities have been seen as major contributors to national and regional economies, and especially through the process of commercializing research results, since buzzwords such as “competitiveness” and “knowledge-based society” entered political environments (COM, 2005). Policymakers increasingly consider knowledge as a source of economic growth and intend to boost the “marketization” of academic science by changing the legislation of higher education and that of IP, as well as the structure of research funding [47]. In Hungary, the Innovation Act (2004) in tandem with new funding mechanisms for university research gave way to similar developments to those of the BD in the U.S.

On the basis of the above considerations, the main aim of this paper is to estimate the capacity of Hungarian universities to conform to the BD model. Several questions arise regarding this objective. For example, it is far from clear whether institutions rooted in an Eastern European post-socialist context show the same patterns of entrepreneurial transformation as their American or Western European counterparts. Although European decision makers demonstrate a great preference for emulating U.S. research policy, it is unlikely that measures modelled after the BD will deliver the same results in a different institutional framework. *Can Hungarian universities be entrepreneurial? Should technology transfer be institutionalized and professionalized, or it can be achieved on an ad hoc basis as well? Is the US-system a good role model for a post-socialist transition economy? Has the BD been the main reason behind the entrepreneurial transformation of American institutions? Should universities become entrepreneurial at all?*

With the ambition of finding answers to these questions, I have studied literature on academic entrepreneurship and visited (formal and informal) forums of university technology transfer officers in Hungary. I also conducted interviews with managers of TTOs at seven prominent Hungarian research universities. My intention was to observe institutions’ efforts to centralize technology transfer and to take account of the problems they encounter while doing so. I used the results of these exploratory inquiries to understand and describe the phenomenon of university entrepreneurship in Hungary (in relation to international literature), to identify problem-areas and to form hypotheses for further research. Before having a closer look at the development of university entrepreneurship in Hungary, first, I give voice to the critics of the third mission to underscore that the entrepreneurial transformation of institutions is not welcomed with equal enthusiasm by scholars. Second, I review the pressures for change in the posture of institutions, with special regard to (what I be-

lieve are) the most important factors: the decrease in government funding and the spread of BD-type legislation. In the main part of the paper, I examine the factors that influence Hungarian universities' capacity to transform hitherto ad hoc technology transfer practices into an organized model in line with the BD, at three intertwining levels: national (*university governance*), organizational (*university culture*), and personal (*the individual scientist*).

2 Controversy about the new mission of higher education institutions: should universities go entrepreneurial?

"The European Union has adopted the goal of becoming the most competitive and dynamic knowledge-based society in the world because it sees knowledge production and diffusion as the engine of economic and social progress" [61]. Accordingly, the EU increasingly urges universities to adopt a third mission so that they can live up to the expectations of being in the heart of the knowledge-based economy:

Co-operation between universities and industry needs to be intensified at national and regional level, as well as geared more effectively towards innovation, the startup of new companies and, more generally, the transfer and dissemination of knowledge. From a competitiveness perspective it is vital that knowledge flows from universities into business and society. *The two main mechanisms through which the knowledge and expertise possessed and developed by universities can flow directly to industry are the licensing of university intellectual property, and spin-off and startup companies* [italics added] [13].

Two important concerns arise from the Commission's approach: (1) *Are traditional academic values at stake if universities increase attention on commercializing research results?* (2) *By emphasizing licensing and spin-off creation as the main mechanisms of knowledge transfer, the EU seems to forget about many, perhaps more important channels of academia-industry interaction.* In what follows, I examine these concerns in more detail.

Treating universities as "patent-factories" is not welcomed at all. Bok [4], already at the beginning of the 1980s, argued that technology transfer "could alter the practice of science in the university" and threatens "the central values and ideals of academic science" (p. 142). Indeed, the Mertonian norms or rather ideals about the driving principles of academic science (communality, universalism, disinterestedness and organized scepticism) are in stark contrast to the emerging philosophy of academic capitalism [64]. Instead of publishing research results, technology transfer emphasizes IP rights and the public good achieved by commercializing inventions. The BD and resulting university IP policies also support this patent-centred philosophy of knowledge transfer.

Critics of *intellectual protectionism* argue that government funded research should be made available to all parties interested, and that public interest is harmed by monopolies over

new technologies, as they eliminate the free exchange of research information and knowledge accumulation. Authors (e.g. Gibbons et al., Hazelkorn, Hellström, Lundvall) [28, 32, 33, 40] express concerns that increased pressures for relying on external sources can divert researchers' attention from their original goals to those of the source of finance.

Nybom [49] believes that the massive politicization of higher education in Europe has led to detrimental changes within universities: in the name of "deregulation and marketization" universities have been proclaimed "anti-innovative" and "ill-adjusted to the real social, economic, etc. problems" (p. 7). Nybom depicts a rather dark picture of the recent trends in higher education, by which universities "through a deadly combination of political incompetence, ideological blindness, economic stupidity, and academic arrogance are gradually disappearing as a living form of institutional order" (pp. 9-10).

Mowery and Sampat [43] also profess the view that government initiatives are based on a poor understanding of the "full spectrum of roles" that universities perform in a knowledge-based society. The authors highlight that the BD model ignores the fact that channels of open science, such as publications, conference presentations, informal interactions between faculty members and industry researchers, or faculty consulting play a much more important role in university-industry interactions than the formal channels of patent licensing and spin-off creation (see Tab. 1).

Tab. 1. Importance of Channels of Information Flow from Public Research to Industrial R&D (as perceived by R&D managers of manufacturing firms located in the U.S.) [11]

Information Source	% Rating it as "Moderately" or "Very" Important for Industrial R&D
Publications & reports	41.2
Informal interaction	35.6
Meetings & conferences	35.1
Consulting	31.8
Contract research	20.9
Recent hires	19.6
Cooperative R&D projects	17.9
Patents	17.5
Licenses	9.5
Personal exchange	5.8

Mowery and Sampat highlight that the various explanations of the new mission of universities (e.g. Triple Helix, Mode 2) tend to disregard the tensions between the different roles of institutions and thus give little support to policymakers [43]. The authors also reckon that there are no proven systems for measuring and evaluating university-industry interactions in national economies, which points to the lack of strong analytical framework for understanding the role of universities within the NIS (ibid.).

As shown by the above examples, the marketization of academic science has resulted in a struggle between the traditional

academic culture and the market culture [16, 23, 41, 48], and led to policymakers' misunderstanding of the ways how universities contribute to industrial innovation and economic competitiveness. The guiding principle for blending entrepreneurial thinking with traditional academic values may be that economic considerations should be welcomed until they do not pose a threat to academic values: "Universities should function in an entrepreneurial fashion, but in an academic sense, not in an economic sense", ergo external funding should always be obtained in order to support academic values and not for its own sake [57].

3 Pressures for change: why universities go entrepreneurial?

Since the mid-1990s the nature of universities has changed dramatically resulting in a shift from the ivory tower atmosphere towards the philosophy of academic capitalism. This transformation has been induced by both "technology pull" and "technology push" motives, which simultaneously increase the level of entrepreneurship within institutions [59]: on the one hand, the growing scientific context of industrial production raises demand for university innovation (especially in the fields of biotech, nanotech, informatics and cognitive sciences), on the other, as a result of shrinking public funding, universities become more proactive in dealing with market needs [65]. Mowery and Sampat [45] believe that industry demand is the more dominant driver of university innovation: on the basis of [11] the authors argue that in most industries (with the exception of pharmaceuticals) university research plays little if any role in generating industrial R&D projects. Instead, it is customers or manufacturing operations that create demand for university R&D. In Hungary however, industry demand for university R&D is rather fragmented, business contracts in general are of very small value [14, 31], which can hamper institutions in developing their innovation capacity [37].

Authors mention several factors that have facilitated the entrepreneurial transformation of institutions. These, among others, include the drop of government funding to higher education [27, 51, 70], the emergence of public debates about the role of universities in society [4, 9, 13] the adoption of BD-type legislation [63, 71]; government expectations to increase the economic returns of publicly funded research [3, 62] the rise in the availability of venture capital and the increase in the supply and mobility of researchers [59] the development of fields of sciences with increased potential for technology transfer (e.g. biotechnology and molecular biology, computer science, and more recently nanotechnology); the growing scientific and technical content of industrial production [27] and the Supreme Court decision in *Diamond v. Chakrabarty* that permitted the patenting of living organisms and thus opened the way for a torrent of biotechnology innovations [42].

In the post World War II years, Western countries witnessed a massive expansion of higher education, which transformed the

theretofore elitist systems into mass education. The economic measures following the recessions of the 1970s and 1980s entailed the review of the systems of education. Decreasing institutional funding raised cost pressures within university operating budgets and intensified the rivalry for research grants and business contracts. In Eastern Europe, the challenges that Western countries had three to four decades to tackle, all came right after the regime change.

To accelerate universities' transformation into the motor of economic development, governments have shifted the direction and channels of budgetary funding from basic to applied sciences and from normative to competitive resources respectively. The reduction in shares of resources from government in parallel with the aforementioned changes in the structure of funding resulted in a more aggressive, entrepreneurial behaviour of universities. In response, institutions developed strategies and organizational forms to fully benefit from *second-stream* (e.g. research grants and contracts from government) and *third-stream* income sources (e.g. grants, contracts, donations, royalty payments, and licence fees from private companies, incomes from spin-offs, student fees) (see Fig. 1). In Hungary, without government grants and business R&D contracts, institutions could not even provide for the basic equipment needed for education and laboratory work [14, 36]. Besides, the growing share of competitive (research) grants within budgetary resources led to growing uncertainty in obtaining funding and thus in the day-to-day operation of institutions [15].

The "Pandora's box" of university technology transfer was opened in the U.S. nearly three decades ago. The BD Act of 1980 permits institutions to retain title to inventions developed on grounds of government funding. In exchange for IP rights, universities are required to file for patent protection, actively promote and attempt to commercialize the invention, as well as to share royalties with the inventor. Researchers are required to disclose inventions to the university-TTO, which in exchange, evaluates the commercial potential of the invention, files for patent protection if necessary, and attempts to market the invention by contacting firms that are interested in licensing the technology, or entrepreneurs capable of launching a startup based on the new technology [63]. In the centre of the process is the TTO-officer, whose personal networks and knowledge of the potential users of the technology are crucial for the success of the model (see Fig. 2).

In the aftermath of the BD, licensing soon became a measure for prestige and potential for advanced, industry-oriented research, attracting a multitude of institutions into the technology transfer arena in the U.S. [3]. In just ten years (1980-1990) the number of institutions with a TTO increased from twenty-five to two hundred (from offices of a single person at less research oriented universities to ones with 30-50 employees at MIT, Stanford or the University of California), while the amount of university patents grew from three hundred to almost 2,000 [18]. In the first ten year of the "BD regime", universities only hoped

Fig. 1. Funding channels for higher education.
Source: [39] with minor adjustments

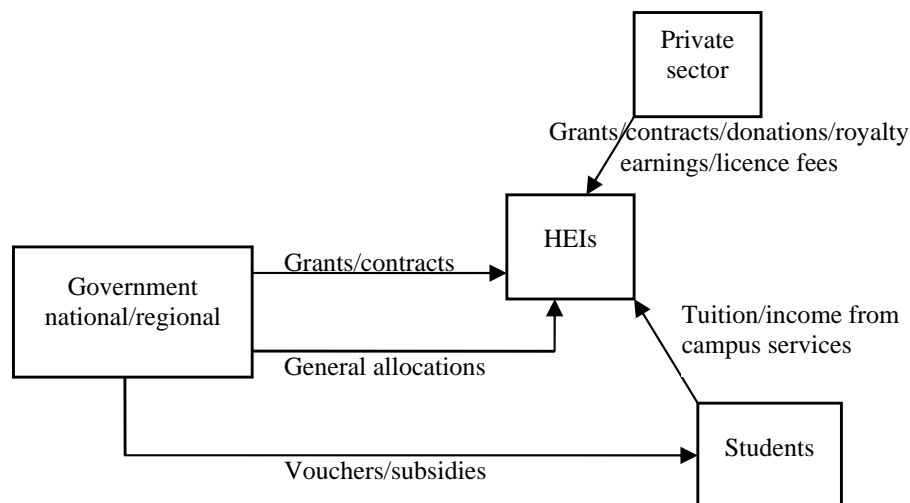
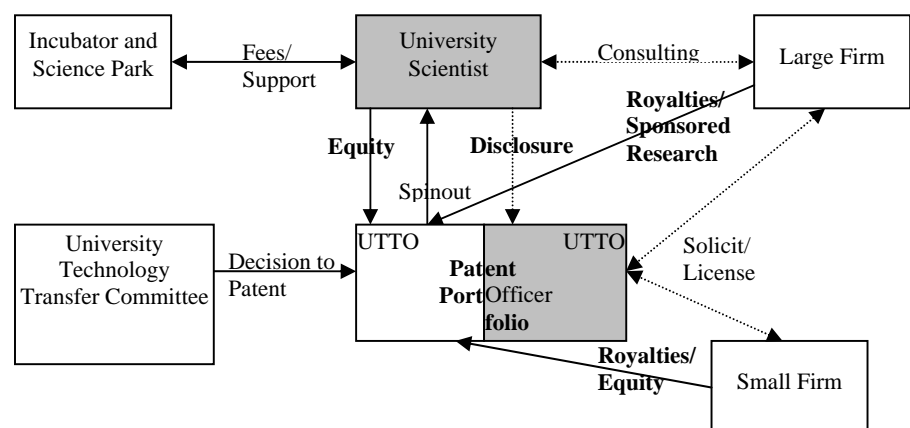


Fig. 2. A process model of (institutionalized) university technology transfer. Shaded areas are potential entrepreneurial actors, Bold Represent Resource Flows. Source: [63]



to earn enough to pay for the running of the TTO, but revenues from technology transfer quickly began to rise.

As emphasized by Etzkowitz [18], the Act created a stable, universal, and secure framework for academia-industry-government relations and made research universities an “explicit part of the U.S. innovation system” (p. 115). Other popular arguments in favour of the Act are that on the one hand, by 1980 the federal government owned title to 28,000 patents but it had licensed only fewer than 4 percent of them; on the other, prior to the Act companies were not guaranteed exclusive marketing rights needed to regain investments into technology development [18,29]. Debates over the economic competitiveness of the U.S. at that time also contributed to the nearly unanimous vote in favour of the Act [44].

Advocates of the BD hold the view that the model not only enhances university budgets, but through product sales it increases government tax revenues, employment, and eventually economic growth. Critics of the model contradict the significance of BD-type legislation in facilitating knowledge flow from the academic sphere to the business sector. Mowery and Sampat [43] reason that the hype around the BD is not supported by empirical evidence, as the patenting and licensing activity of U.S. institutions, as well as the growth in the numbers of TTOs and

staff began to accelerate well before the passage of the Act. Examining three leading U.S. institutions, Mowery, Nelson, Sampat and Ziedonis conclude that “Bayh-Dole is only one of several factors behind increased patenting and licensing” (p. 27), but not as determinative as it is frequently asserted to be.

4 The entrepreneurial capacity of Hungarian universities

The main factor that determines the market-sensitivity of universities in Hungary is historical. After WWII, the Hungarian R&D sector was tailored in line with the Soviet model: the autonomy of universities practically disappeared, research institutions were placed outside the academic sphere, and university-industry relations weakened. During the economic hard times following the regime change, R&D and innovation significantly receded as a priority issue [37]: the number of research staff and the amount of R&D expenditures (and especially that of businesses) declined in parallel with firms’ willingness to innovate. Examining two Hungarian technical universities, Török and Papanek [66] find that faculty members collaborate with industry only occasionally, while regular contract research is less typical. Havas and Nyiri [31] highlight that in Hungary the level of university-industry cooperation was rather low in comparison

to the EU15 between 1999 and 2001, and it further declined in the period of 2002-2004. Until the end of the 1990s, Hungarian science policy was based on the linear conception of innovation, thus funding programs did not support interactivity between institutions and industry. It was only at the turn of the millennium, when economic trends had been somewhat normalized that the government began to stimulate interactive technology transfer.

Following the U.S. example, several EU members (Belgium in the 1990s; Germany, Norway and Denmark in 2001; Austria in 2002; Hungary in 2004; Italy in 2005; etc.) adopted some form of the BD framework in the past two decades, expecting to boost their innovation performance. The “Hungarian BD”, enforced in 2005, rearranged the regulation of IP born by institutions: the Innovation Act requires universities to establish IP policies, allows faculty members to set up utilizing enterprises (spin-offs), and permits them to be hired by these spin-off companies [6]. Legal incentives have been coupled with competitive funding for applied research, provided by mechanisms of the Innovation Fund. The Fund is a novel way of financing R&D and innovation programs in Hungary: it rests on a turnover-based levy of businesses, complemented with a similar amount transferred by the government [34].

Depending on the commitment of university administrators and the spheres of interests within institutions, universities embarked on to institutionalize technology transfer with varying resilience: some have established university-TTOs and even formulated invention evaluation and protection systems, mainly drawing on foreign examples, but others have shown slight willingness to go further than the minimal formalities (e.g. web publishing of university IP policies) required by the law.

In what follows, I examine the factors I regard as highly significant relative to institutions’ ability of implementing the BD model. I depict the determinants of university entrepreneurship in an onion model of three concentric circles (see Fig. 3): (1) The *system of university governance* is determined at national level, when the government sets the degree of university autonomy in financial and academic issues by legislation. (2) Since *culture* is the most difficult organizational attribute to change [60], it has a strong bearing on universities’ capacity for entrepreneurial transformation. (3) In the centre of the framework, there is the *individual scientist*, whose attitude to entrepreneurship is highly dependent on the organizational and socio-economic setting. All three components of the framework are embedded in and shaped by the social, economic, and cultural environment of the given country that is Hungary in the present case.

University governance

The governance model of higher education influences institutions’ ability to develop their entrepreneurial skills to a great extent, as well as their capacity to adapt to and profit from environmental changes. University governance systems today have to meet different challenges to those of previous centuries [36].

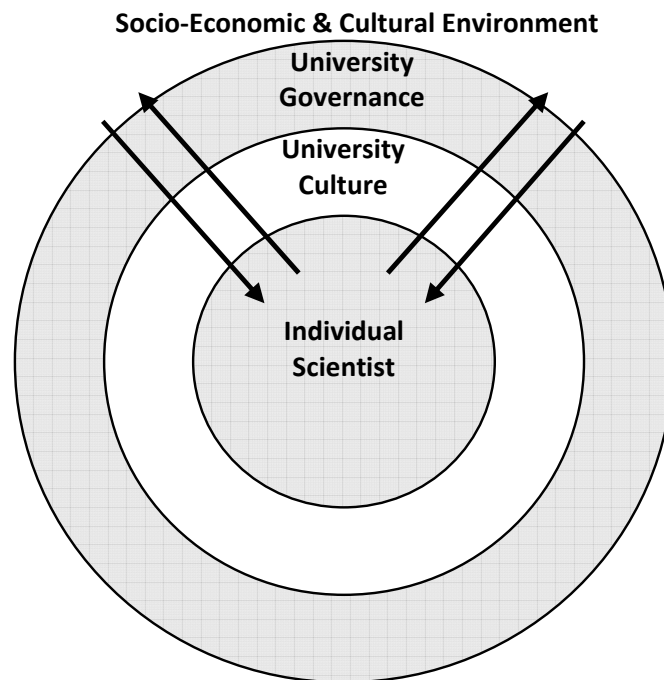


Fig. 3. Conceptual Framework for Analysing the University’s Capacity for Academic Entrepreneurship

According to [9], the coordination of higher education systems is determined by the distribution of power between three forces: the *government*, the *market*, and the *academic community*. In the *European continental model*, also characteristic of Hungary, the central state has a strong influence on how universities are governed: it regulates access conditions, the curriculum, the degree requirements, and the appointment and remuneration of academics [38]. The academic community (represented by the Senate) also maintains considerable authority in internal university affairs, especially regarding the content of education and research. The third apex of the triangle, university administration is relatively weak and has narrow latitude for exercising power. Van Vught [69] entitles the European tradition a “state control model”, as contrasted to the “state supervising model”, which is typical of the Anglo-American tradition. Fielden ([26] distinguishes between four models of university governance (“State Control”, “Semi-Autonomous”, “Semi-Independent” and “Independent”), and stresses that higher education systems in general are gradually shifting from state control towards one of state supervision (p. 11). Close state control was lacking in British and U.S. systems, which has been a major reason for American institutions’ higher responsiveness to market needs [2, 58].

In spite of the regime change, the close government control over the financial management of Hungarian universities did not relieve. Although the Higher Education Act of 1993 strengthened the autonomy of the academic sphere, economic independence of institutions was not even in question [1]. In addition, regulations on university budget became more stringent, bureaucratic, and confusing, while except for fee-paying teaching programs, entrepreneurial activities were regarded undesir-

able [35]. Declining public funding, growing competition for students, and the need for adapting curricula to market economy needs have raised pressures on universities for a greater degree of self-management. But the slow adjustment of the regulatory framework to the new environment has embroiled institutions into a “schizophrenic situation”: on the one hand, they are urged to become more entrepreneurial and market-oriented, on the other, they have to submit to close government control, and especially regarding financial issues [46].

Besides aligning Hungarian higher education to the European system in line with the Bologna process, the new Higher Education Act (ratified in 2007) attempted to professionalize the governance of institutions in order to increase the efficiency of university operation. But the high ambitions have fallen by way-side due to the conflicting interests of the state and universities [55], when institutions objected to increasing the influence of “outsiders” (e.g. government officials, private sector experts) on internal university affairs. The running of Hungarian universities was described as “amateurish” by Barakonyi [1] prior to the new Act, and the situation has not changed much since then. Albeit universities now enjoy a relatively high autonomy in entrepreneurial issues (e.g. they can obtain loans, start business enterprises, and commercialize IP), their governance on the whole remained unchanged (they kept their “government institution” status) while their management (internal governance) can still be regarded as *collegial*, that is characterized by equal sharing of authority by leading professors.

Despite political ambitions to see public universities led by strong, outward-looking professionals, it seems that the shift towards *state supervision* and *managerial* culture is unlikely to take place without universities’ consent. Organizational changes required for full transformation can easily fall victim of the conflicting interests between university administration, academic scientists, and the government. It seems that universities are more afraid of the market forces than they believe in their benefits to higher education, and indeed, institutions are quite content with the present situation, which resembles more to “market socialism” than to market economy [56].

University culture

Universities in Hungary and in most European countries (with the exception of the U.K.) can be regarded as highly “bureaucratic” and “oligarchic” with typical Weberian and Humboldtian structures. The greatest disadvantage of this model is that it is very resistant to change and the least interested in opening up to the needs of the market and external stakeholders [38].

Wilhelm von Humboldt’s ideas on how universities should be run have had a major influence on the construction, functioning and organizational culture of European universities up to present times. Von Humboldt envisioned a university in which knowledge creation and transmission is uninterested and uncorrupted, i.e. not influenced or hijacked by politics, the economy, or religion. In a Humboldtian institution academics enjoy “the greatest

possible autonomy” and have a conviction that besides impartial education and research, they have no other social obligations [50]. Even today, many scientists hide behind this ideology to distance themselves from social responsibilities [68].

The fundamental characteristics of the Humboldtian university model (high specialization of academics, organizational fragmentation, high distribution of decision-making authority, and the merit-based omnipotence of leading professors) can impede quick, entrepreneurial decision-making often needed in the course of day-to-day university-business interactions. As R&D is usually carried out on interdisciplinary domain, requiring the collaboration of faculty members from several fields of science, Humboldtian structures can detain the successful completion of large-scale multi-discipline research projects.

As van Vught puts it, extreme organizational fragmentation can eventuate that the university becomes a random and ineffective federation of sovereign mini-states that are concerned only with their own interests – they are not interested in the welfare of their federal allies, nor of the institution as a whole, nor of the society of which they form part [68].

Examining three Hungarian research universities, Veroszta [67] finds that in spite of the growing dependence on market forces, positions that require managerial decision making are typically filled internally, by teachers or researchers. Hence, there is a wide array of university heads in the same institution, from ones with exceptionally strong entrepreneurial attitude to others with strictly academic thinking. Due to this variation in attitudes and the differences in the technology transfer potential of different fields of science, some departments have much greater capacity to attract external sources of revenue than others. Disparity in income-generating capabilities, along with the high autonomy of departments and the lack of income redistribution systems can give rise to strong inequalities among faculty members, and eventually deteriorate their attitude towards entrepreneurship.

The individual scientist

In a “bottom heavy knowledge institution, grass-roots innovation is a crucial form of change” [10]. Endeavours to introduce organized technology transfer to Hungarian universities are unlikely to succeed without understanding the motivations of the individual scientist. At this point we should take a broader perspective, as research on university entrepreneurship, and especially at individual level, is embedded in that of entrepreneurship. The key entrepreneurial traits as summarized by Chell [8] are: the need for achievement, internal locus of control¹, risk-taking, proactive personality, entrepreneurial self-efficacy, perseverance, intuitive decision-making style, social competence (networking capability), and the need for independence.

¹People with an internal locus of control (LOC) are those who believe that they are in control of their own destiny. In contrast, people with an external LOC conceive that fate has a dominating influence over their lives (Levenson, 1973; as cited in Chell, 2008)[8].

Examining the reasons behind the low level of spin-off creation in Hungary, Buzás [7] finds that researchers in general have a low tolerance of risks and a high fear of failure, business ties, and insecurity associated with entrepreneurship. These negative associations are reinforced by scientists' insufficient business administration knowledge and entrepreneurial competences. In addition, it is highly demanding to perform as a researcher and an educator simultaneously. On the basis of official statistics, Papanek and Borsi [52] argue that "many Hungarian researchers do not [even] think about making business use of the research results achieved". As universities in general assess and reward faculty members by their publication and citation records, established promotion systems do not motivate researchers either to increase their technology transfer activity.

Intrapreneurship, i.e. entrepreneurship within established organizations, is a more adequate term to describe scientists engaged in technology transfer. Intrapreneurs are "entrepreneurial individuals, who are able to innovate within traditional large organizations, and who do so by challenging bureaucracy and creating successful operations in spite of, rather than in line with, the organizational culture and strategic aims of the company" [61]. Although some "academic intrapreneurs" [53] in Hungary have managed to establish successful research enterprises outside traditional university structures, they tend to resort to university infrastructure and goodwill without paying adequate (or any) compensation to the institution. As a result only a small fraction of the contract value, disclosed to legitimize the use of research infrastructure, appear as university resource [15]. This individualistic and sometimes unethical approach to entrepreneurship can significantly hinder the efforts to centralize university technology transfer in Hungary. As explained by Inzelt [36], the ideological basis of these private (or rather "pirate") academic ventures originates from socialist times, and has served as a survival strategy for entrepreneurial academics since the regime change. The practice emerged as a result of researchers' relatively low living standards and the lack of university IP policies. Although by today all institutions have had to formulate IP management policies to comply with the law (including regulations about invention disclosure and income distribution), ingrained reflexes can hardly be changed with the stroke of a pen.

5 Conclusion

In this paper I discussed the various interpretations, critique, and causes of the new mission of higher education institutions, i.e. the commercialization of research results. I also examined the factors that shape Hungarian institutions' ability for adopting the Bayh-Dole model of technology transfer. These investigations are highly relevant at present, for at least two reasons. First, the Innovation Act of 2004 requires Hungarian universities to centralize and professionalize hitherto ad hoc technology transfer activities. Second, although academic entrepreneurship has been examined (more or less) thoroughly in American and

Western European contexts, the development and characteristics of the phenomenon have not been investigated and documented extensively in Eastern Europe.

The Hungarian NIS experienced fundamental changes in the first decade of the new millennium, when the government laid down the cornerstones of the new innovation system: (1) the BD-type innovation act, (2) the Innovation Fund, and (3) a government office for devising and implementing national R&D and innovation programs. Emulating the BD is a very attractive solution for satisfying the need for a modern research policy, but the much-vaunted results of the model may not be achieved in a country with a completely different institutional environment to that of the U.S. The BD has been devised for a well-established NIS with a long history of university-industry cooperation. Entrepreneurial American institutions has adjusted their organizational structures with ease to the philosophy of the BD, but it is more than doubtful that their Eastern European counterparts embedded in a nascent innovation system can make similarly good use of the ownership of IP.

In Hungary, the relatively weak links between universities and the industry derives mainly from the country's socialist past that still has repercussions on the environment, governance and culture of institutions, as well as on faculties attitude to entrepreneurship. Both literature sources and my empirical investigations suggest that, at present, neither the governance model, nor the organizational culture of Hungarian institutions is in line with the philosophy and mechanisms of the BD model. The picture is more blurred at individual level. Whilst many researchers have been inactive in technology transfer so far, there is a small group with exceptionally developed entrepreneurial competences and extensive industrial linkages. The former are most likely to be indifferent to organized transfer, while the latter have already configured their business ties and working relationships, which they are reluctant to share with the university. This conjecture however, should be treated with care and needs to be further investigated.

Although the BD model of organized technology transfer is in the embryonic stage of development in Hungary, it has already become clear that changes initiated solely by the state will hardly be enough to alter norms, attitudes and patterns of behaviour developed in the course of many years. Government efforts to increase the role of universities in industrial innovation are important but insufficient to make entrepreneurial thinking the standard within ivory towers. As Shattock [61] puts it, "breaking down the bureaucratic barriers to entrepreneurialism in universities is probably at least as important as incentivising it through new financial mechanisms."

Tab. 2. Acronyms used in this paper

BD	Bayh-Dole (Act)
HEI	Higher Education Institution
IP	Intellectual Property
MIT	Massachusetts Institute of Technology
NIS	National Innovation System
R&D	Research and Development
TTO	Technology Transfer Office
UTTO	University Technology Transfer Office

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